PB87-194742

Cooperative Research in Atmospheric Science under the US-PRC (United States-People's Republic of China) Environmental Protection Protocol

(U.S.) Environmental Protection Agency
Research Triangle Park, NC

1987

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. REC PB87-194742
EPA/600/M-87/017		

4. TITLE AND SUBTITLE
COOPERATIVE RESEARCH IN ATMOSPHERIC SCIENCE UNDER THE US-PRC ENVIRONMENTAL PROTOCOL

5. REPORT DATE
1987

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
W.E. Wilson

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
(Same as Block 12)

10. PROGRAM ELEMENT NO.
A101/B/71/07 - 5035 (FY-87)

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS
Atmospheric Sciences Research Laboratory - RTP, NC
Office of Research and Development
U.S. Environmental Protection Agency
Research Triangle Park, N.C. 27711

13. TYPE OF REPORT AND PERIOD COVERED

14. SPONSORING AGENCY CODE
EPA/600/09

15. SUPPLEMENTARY NOTES
China Exchange News, National Academy of Sciences, 15(2):18-21, June 1987

16. ABSTRACT
ASRL's efforts in arranging cooperative research projects under the US-PRC Environmental Protection Protocol are described. Completed and ongoing projects are reported and projects now being negotiated are noted.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
RELEASE TO PUBLIC	UNCLASSIFIED	6
	20. SECURITY CLASS (This page) UNCLASSIFIED	22. PRICE

NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Cooperative Research in Atmospheric Science Under the US-PRC Environmental Protection Protocol

WILLIAM E. WILSON
US Environmental Protection Agency

Dr. Wilson is a supervisory research chemist in the Atmospheric Sciences Research Laboratory, US Environmental Protection Agency (EPA), Research Triangle Park, North Carolina, and an adjunct professor in the environmental sciences and engineering department of the University of North Carolina. In addition to his other duties, he has served since 1980 as program manager of cooperative research in atmospheric science with the People's Republic of China. He would be pleased to hear from scientists who are participating or would like to participate in cooperative studies with China in his area of responsibility.

Planning for cooperative research involving the Atmospheric Sciences Research Laboratory (ASRL) of the US EPA and the State Environmental Protection Bureau of the PRC began in 1980 when an EPA delegation including working scientists went to China. The delegation broke into a water group, a health effects group, and an air group. As the representative of the ASRL in the air group, I was invited to give lectures at the Institute of Atmospheric Physics (IAP) and the Institute of Environmental Chemistry (IEC) of the Chinese Academy of Sciences.

At the time of our trip the State Environmental Protection Bureau had just been formed. Its administrative structure existed, but it had no research labs and only a skeleton scientific staff. Therefore, our scientific contacts and discussions of cooperative research were with groups already in operation, namely the IAP, the IEC, and the environmental chemistry group at Peking University.

During this visit I became acquainted with four Chinese scientists. Su Weihan, a chemist at IEC; Zhang Xifu, a meteorologist at IAP; Tang Xiaoyan, a chemist at Peking University and consultant to the State Environmental Protection Bureau, and Wang Wenxing, the senior air pollution scientist for the same Bureau. I was to have considerable contact with these scientists throughout following years and during subsequent trips to China.

Our discussions continued early in 1981 when I hosted two five-member delegations from China. However, specific projects then negotiated with IAP and IEC were delayed due in part to China's absorption with the trial of the "Gang of Four." Contacts were resumed in 1983 and in the spring of 1984 I went to Beijing to finalize plans for two cooperative studies.

The Tracer Study

The largest study involved cooperation with the CAS Institute of Atmospheric Physics (IAP). When I visited this Institute in 1980, they had just completed a 1000-foot (ft) high meteorological tower and were beginning to install instruments on it. The instruments, located at several levels on the tower, provided an exceptionally good measurement of the vertical structure of the wind field. There are only three such towers in the world, one in China, one in the USSR, and one in the US. The one in the US is in a rural location; the one in China is in Beijing where the urban area produces a more complex wind field. Thus, a unique situation existed in which the turbulent fluctuations of the wind field over an urban area could be accurately characterized to the height of 1000 ft and the dispersion and transport of a tracer measured. This was relevant to long-range transport of pollutants from tall stacks, then and now an active area of research in the US.

Negotiations for a tracer study began in 1980, continued with the visits of Chinese to the US in 1981 and 1983, and were finalized following my visit in 1984. The Americans contributed to the study by providing

China Exchange News
National Academy of Sciences,
15(2):18-21, June 1987

equipment for collecting and analyzing the tracer and instruments for continuous analyses of the tracer. The Chinese provided the tracer, manpower, and logistics and also arranged to obtain additional meteorological data. As part of our agreement, the Chinese paid for the tracer, and the US gave the IAP several of the instruments used to measure tracer concentration.

The extensive tracer investigation, conducted downwind of Beijing during 1984, was a cooperative program involving the IAP, the Laboratory for Atmospheric Research of Washington State University, and the Meteorological Division of ASRL. Robert Eskridge of the National Oceanic and Atmospheric Association (NOAA), assigned to the EPA, was the EPA project officer, Brian Lamb the US principal investigator (PI), and Zhang Xifu his Chinese counterpart. Dr. Lamb and two of his colleagues went to China to participate in the field study. The purpose of the experiment was to obtain a quantitative data base of gas transport and diffusion to distances beyond 100 kilometers (km). Sulfur hexafluoride (SF_6) tracer was released from the 1000-ft tower in Beijing during four experiments in October and November.

The data collected during the Beijing tracer study represents a detailed description of pollutant transport from an urban area across a rural plain. The multilevel wind, temperature, and turbulence measurements from the Beijing tower and other sites combined with the repeated crosswind profiles of SF_6 at the surface and aloft at distances out to 150 km yield a unique set of atmospheric diffusion data. As a result, the analysis of the tracer and meteorological data will be a valuable addition to our understanding of mesoscale diffusion phenomena.

The multilevel wind, temperature, and turbulence measurements from the Beijing tower and other sites combined with the repeated crosswind profiles of SF_6 at the surface and aloft at distances out to 150 km yield a unique set of atmospheric diffusion data.

Air Pollution

Negotiations with the Institute of Environmental Chemistry, begun in 1980, also came to fruition in 1984. At that time very little was known about Chinese air pollution. It was assumed that the large amount of coal burned for electrical power, cooking and heating, should produce higher SO_2 concentrations in China than in the US. Because of the low population of motor vehicles, however, it was believed that China should have less NO_2 and hydrocarbons than the US and therefore less ozone. In this less-oxidizing atmosphere, SO_2 conversion rates might be limited by availability of oxidantor influenced more by catalytic reactions. Therefore it was of interest to the US to participate in a study of SO_2 conversion rates and a general characterization of the Chinese air quality. The US participated by agreeing to loan some instruments to the IEC and to analyze some samples in the US.

Sulphur dioxide, light scattering, and aerosol size and concentration were measured at eight sites within the Beijing-Tianjin corridor during three summer and two winter intensive study periods. These data have been analyzed to determine the rate of conversion of SO_2 to sulfate, the conversion mechanisms, and the contribution of various aerosol components to light scattering and visibility reduction. Observations in China have been compared with similar observations in the US.

Su Weihan of the IEC will report the results of this study at the American Association for Aerosol Research Meeting in Seattle in September 1987 in his paper, "Aerosol Size and Composition in the Beijing-Tianjin Area of the People's Republic of China: Effects on Visibility and Sulfate Formation."

One interesting aspect to this study was the ozone measurements. In contrast to expectations, significant concentrations of ozone in China were observed during the summertime, frequently exceeding the US air quality standard for ozone. In contrast to the experience in the US, ozone peaks were frequently observed at night. We are currently trying to understand these observations.

A Continental Background Site in China

During my visit in 1984 my Chinese hosts began to ask about acid rain research, since they were aware of the major effort on acid rain being undertaken in the US. The Chinese had received reports of trees dying in mountain forests in China and they wanted to find out if acid rain might be a problem there. One area of interest to American groups involved in acid rain research was in improving the global monitoring of background rain chemistry. NOAA, a member of the National Acid Precipitation Assessment Program (NAPAP), manages a Global Trends Network (GTN) with perhaps a dozen stations around the world, most of them island or coastal sites. A need exists for a clean continental site.

After being informed of the US interest in a continental background site, the State Environmental Protection Bureau investigated several areas in northeast

and northwest China but found too much industry. It is difficult to find an area in the temperate zone with rain but no pollution. An area with rain will usually be heavily populated. The Chinese eventually chose an area in Yunnan Province in southwest China as the best possibility, identifying three possible sites in western Yunnan between the town of Lijiang and the border with Burma. In the fall of 1986 I visited this area with representatives of the national, provincial, and local Lijiang area environmental protection units. Lijiang is a small, very clean town, about 6000 ft in altitude. Its only industry is a small cement factory. The area had only recently been opened to tourists. We visited three prospective sites for the GTN station. The best site is about 70 km from Lijiang. It is in a conservation area, similar to a US wilderness area, where no commerical tree cutting, road building, or industrial activities are allowed. The site is in a large natural clearing in a spruce forest near the foot of the 16,500 ft, glacier-covered Jade Dragon Mountain.

The State Environmental Protection Bureau has assigned two recent graduates from Yunnan University to work there. After four years at the site they will be sent to the US to work for a year.

Dr. James Galloway of the University of Virginia operates the GTN program for NOAA. His field director, Dr. William Keene, will visit China in April 1987 to inspect the the site. If the site is acceptable, he will give final training to the Chinese staff, arrange for shipment of samples to the US, and initiate the program. Two sets of samples will be collected. One sample will be sent to the US for analysis and the other will be analyzed in China. The results will be compared. The rain will be analyzed for pH, sulfate, nitrate, chloride, ammonium, potassium, calcium and perhaps other ions.

Further Observations During Fall 1986

By 1985 the State Environmental Protection Bureau had begun to build research laboratories and had established the Chinese Research Academy of Environmental Sciences (CRAES), with Wang Wenxing as its deputy director. In 1986 I went to China again to visit the new laboratories of CRAES, to continue discussions of acid rain research, and to start developing cooperative programs with the State Environmental Protection Bureau. Now that the Bureau had its own facilities and staff, it hoped for direct US-PRC cooperation. Since CRAES supports a Center for Environmental Sciences at Peking University, cooperation with that group was considered equivalent to cooperation with the Bureau. As a result I was able to spend fall of 1986 giving a course on acid rain chemistry at Peking University as a visiting professor in the atmospheric chemistry section of the Department of Technical Physics.

While at Peking University I took a very interesting trip with Su Weihan, who is now also director of the Atmospheric Chemistry Laboratory of the Chinese Academy of Meteorological Sciences. We visited a background site near Hangzhou that was established by the Academy at the request of the World Meteorological Organization (WMO). WMO defines a background site as one more than six km from the nearest major point source. Today's atmospheric scientists would probably call this a regional pollution site, not a background site. The Chinese Academy of Meteorological Sciences has built three of these sites and is building two more in China. They are all within 200 km of a major population center so would not be considered background sites. However, they might be useful for measurements of regional pollution or to determine emission rates of materials like N_2O, CH_4 and freons, which are of interest for global chemistry studies.

There are several reasons why the US EPA should support cooperative research with the State Environmental Protection Bureau. Many air pollution problems are global in nature; any cooperation with a major nation such as China that helps that nation understand the global aspects of and deal with its pollution problems better should ultimately help the US as well.

The station we visited near Hangzhou was well built, very expensive and much nicer than comparable stations in the US. The Academy had run electrical power lines for several miles, built a lake to provide water, a 12-room laboratory with a lovely Chinese garden in the center, constructed a 500-step concrete walk from the laboratory to the collection site at the top of the hill, and a two-room laboratory near the top of the hill. Turbidity is measured once a day when clouds are not present. Measurements of acid rain are also being made, but the State Environmental Protection Bureau also measures acid rain in this area.

Conclusion

There are several reasons why the US EPA should support cooperative research with the State Environ-

mental Protection Bureau. Many air pollution problems are global in nature; any cooperation with a major nation such as China that helps that nation understand the global aspects of and deal with its pollution problems better should ultimately help the US as well. China has certain unique facilities and features which may enable experiments to be conducted that could not be done elsewhere, e.g., the transport and dispersion study using the instrumented tower in Beijing. The composition of air pollution in China may differ in some aspects from that in the US, allowing us to isolate and study certain types of reactions more conveniently there than in this country.

Each individual study currently underway is designed to have scientific benefits for both the US and China. However, an underlying purpose of much of the atmospheric chemistry program is to help the Chinese improve their capability of making the environmental measurements needed to support effects studies. Cause-and-effect relationships can be more easily determined in China because its high pollution gives a strong, clear signal. Because of lower pollution levels in the US, it is more difficult to differentiate effects caused by pollution from effects caused by other factors.

Cause-and-effect relationships can be more easily determined in China because its high pollution gives a strong, clear signal.

During my 1986 trips to China arrangements were made to initiate a number of new studies, described below.

- A study of the reactions and products of aromatichydrocarbons in smog using a smog chamber and longpath Fourier-Transform Infrared Spectrometer at CRAES. Wang Wenxing, Chinese PI; Richard Kamens, University of North Carolina, US PI.

- A study of the role of carbon soot particles in the conversion of SO_2 to sulfate with the CAS Institute of Environmental Chemistry. Su Weihan, Chinese PI; Tisa Novakov, Lawrence Berkeley Laboratory, US PI.

- Measurement of hydrocarbon reactivity by the OH-rate technique with the Center for Environmental Studies at Peking University. Tang Xiaoyan, Chinese PI; Richard Kamens, UNC, US PI.

- Measurement and modeling of hydrocarbon peroxide produced in smog chamber studies with the atmospheric chemistry section, Peking University. Zhang Junfeng; Chinese PI, William E. Wilson, US PI.

- Application of new techniques in aerosol collection and measurement and source apportionment modeling to pollution in China. Application of these techniques to measurements of aerosols for a study of the effects of particles on lung function and respiratory health. Wang Wenxing, Chinese PI; Paul Lioy, Robert Wood Johnson Medical School, Rutgers University, US PI.

- Measurement of deposition of pollutants to mountain forests. Su Weihan, IEC; and Tang Xiaoyan, Peking University, Chinese PIs; William E. Wilson, US PI. The Peking University study is supported by CRAES. IEC has a similar study on a mountain in a different part of China.

- We are also discussing a new study of dispersion in complex terrain with Zhang Xifu. If the State Environmental Protection Bureau decides to participate in this program, the US EPA will probably participate in and provide some support as well.

- Through the Environmental Monitoring and Support Laboratory, EPA will provide calibration samples for analysis of ions in rain.

The State Environmental Protection Bureau is especially interested in having its scientists study and work in this country. In response to their request we have made arrangements for several Chinese scientists to work in American universities on topics of mutual interest. This year Guo Zhishi from CRAES is studying the smog reactions and products of polynuclear aromatics from coal combustion with Richard Kamens at UNC. During the next school year two more Chinese scientists will come to the US. Li Jinlong from the atmospheric chemistry section of Peking University will work on chemical kinetic modeling and smog chamber measurements with Harvey Jeffries of UNC; Tang Dagang from CRAES will measure the reactions of SO_2 in aerosol particles in the presence of ozone with Peter McMurray of the University of Minnesota.